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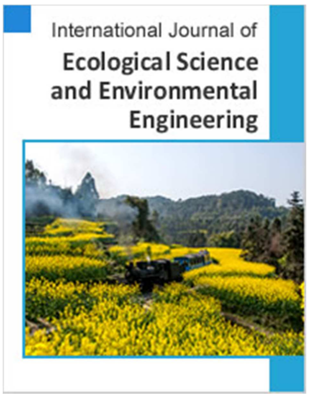


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# Soil Fertility and Management Practises Under Different Landuse Types in Irepodun Local Government of Kwara State, Nigeria

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## Abstract

The study examined the soil fertility and management practices under different landuse types in Irepodun Local Government of Kwara State. Field sampling was carried out using a quadrant of 60metres by 60metres (5) samples per agricultural landuse (at four corners and middle of the quadrant) was drawn and total of 30 soil samples were collected from both layers (0-30cm and 30-60cm) to a 60cm as to eliminate bias. The samples were then coagulated into six (6) samples by taking means of the 10 samples per location. The six samples were them plotted and interpolated using inverse distance weighted interpolation techniques in ArcGIS to show the spatial distribution of the samples across the study area and statistics (T-test) was used to analysed the data. The agricultural land use practice in the study area has not really affected both physical and chemical composition of the soil. The major reason is that the soil in the study area is endowed with soil organic matter and this plays a significant role in boosting soil fertility and helps to control microbial activity which serves as a source of carbon and nitrogen. To avoid soil degradation and complete crop failure, farmers should be enlightened on soil management as well as the application of appropriate and adequate amount of fertilizer. The study thus put forward a number of recommendations towards improving soil fertility and management practices of the farmland in the study area.

## 1. Introduction

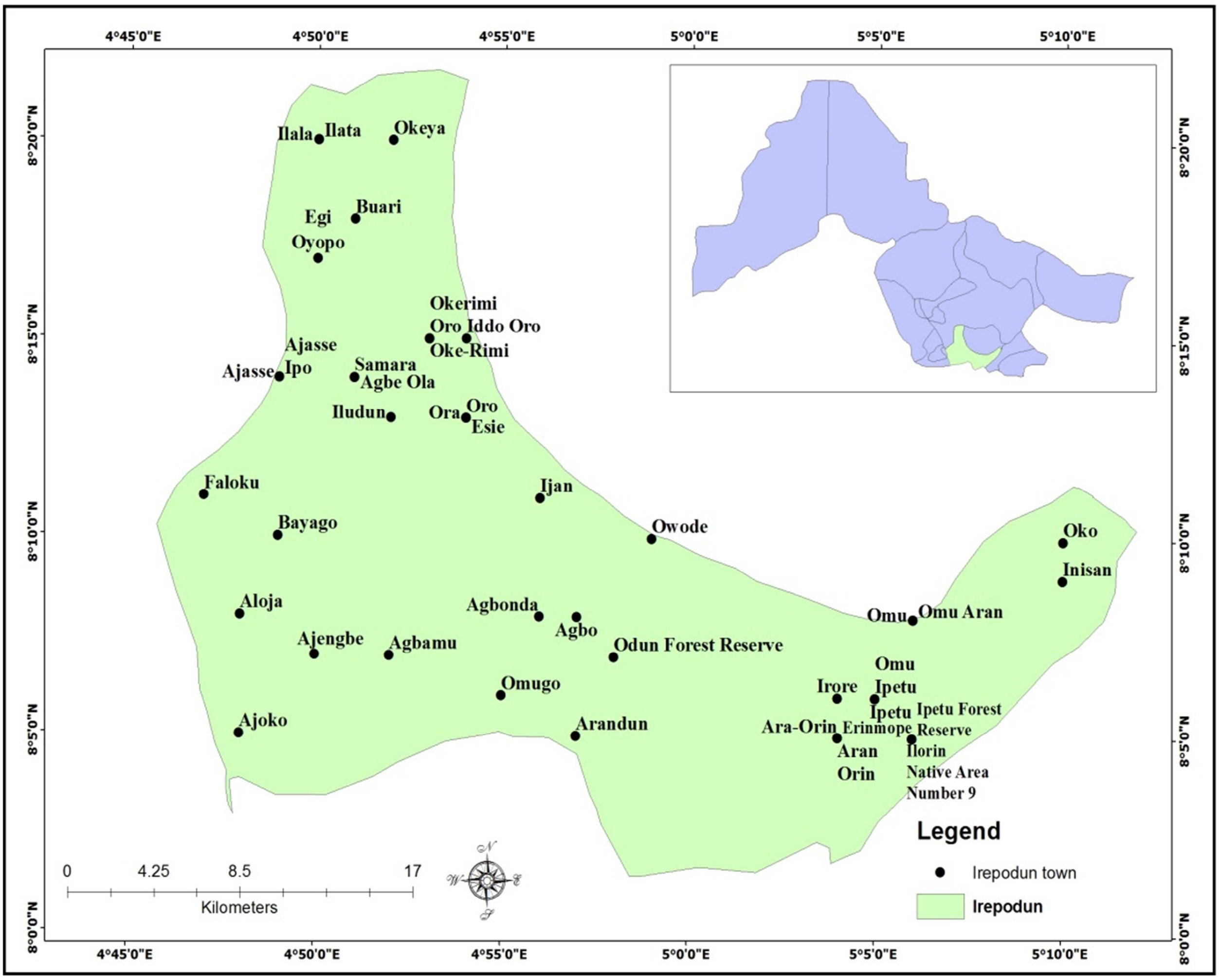
Soil fertility maintenance is a major concern in tropical Africa, particularly with the rapid population increase, which has occurred in the past few decades. The causes of land degradation are cultivation on steep and fragile soils with inadequate investments in soil conservation or vegetation cover, erratic and erosive rainfall patterns, declining use of fallow, limited recycling of dung and crop residues to the soil, limited application of external sources of plant nutrients, deforestation and overgrazing [1]. Therefore, reducing resource degradation, increasing agricultural productivity, reducing poverty, and achieving food security are major challenges of the countries in tropical Africa. Thus, every effort should be directed to maintain the physical, biological and socio-economic environment for production of food crops, livestock. Soil organic matter not only plays a major role in soil fertility by affecting physical and chemical properties, but also controls soil microbial activity by serving as a source of mineralizable carbon and nitrogen. In mature and undisturbed tropical ecosystems, a balance exists between the organic carbon input and output of the soil because of mineralization and leaching of dissolved organic matter [10].

Soil fertility and plant nutrition are two closely related subjects that emphasize the forms and availability of nutrients in soils, their movement to and their uptake by roots, and the utilization of nutrients within plants [5]. Without maintaining soil fertility, one cannot talk about increment of agricultural production in feeding the alarmingly increasing population. Therefore, to get optimum, sustained-long lasting and self-sufficient crop production, soil fertility has to be maintained.

When the soil does not supply sufficient nutrients for normal plant development and optimum productivity, application of supplemental nutrients is required. The proper application rates of plant nutrients are determined by knowledge about the nutrient requirement of the crop and the nutrient supplying power of the soil. The nutrient supplying power of a soil depends on dissociation of the nutrients from the exchange site, which is in turn dependent on the degree of saturation of the nutrients on the exchange site, type of clay and complementary ion effect [5]. Continued removals of nutrients, with little or no replacement have aggravated the potential for future nutrient related plant stress and yield loss. Therefore, evaluating the fertility status of a soil is important to know the productivity of a soil as soil fertility is one of the parameters of soil productivity.

## 2. The Study Area

Irepodun local Government area of Kwara State, Nigeria is the study area and it's headquarter is in Omuaran. This area is situated on latitude 8°15'N of the equator and longitude 5°0'E [7]. It has a land mass of about 737km$^2$ with eleven wards and 30 towns (Figure 1). Omuaran is the seat of power with eleven wards and six area Offices for administrative services. It shares boundary with Ifelodun Local Government Area in the North, Osun Local Government Area in the South, Ekiti and Offa Local Government Area in the east and West respectively [6].



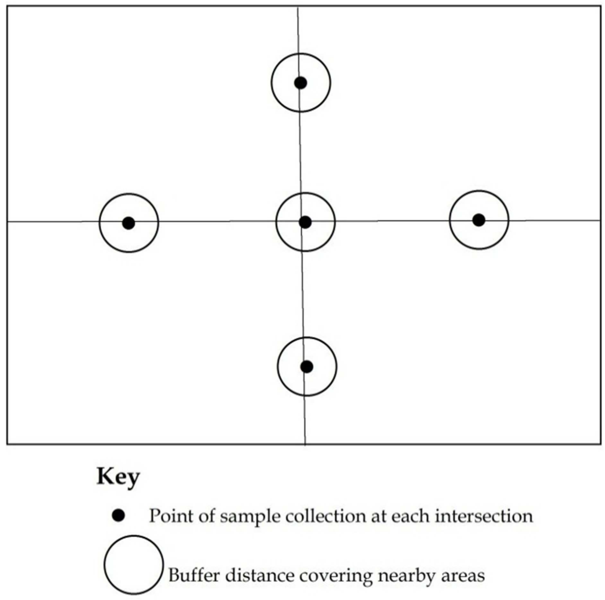

Source: Author's Fieldwork, 2016.

***Figure 1.*** *Irepodun Local Government of Kwara State: The Study Area.*

## 3. Methodology

Soil samples were taken from selected farmlands in the study area. A GPS receiver was used to locate the sampling points. On each field, a demarcated subfield of (60m x 60m) was demarcated for sampling for each of the selected farmlands (figure 2). Each farmland was sampled to a 60cm to eliminate bias. Sample points were randomly located and a composite sample was prepared from pre-determined depth of 0-30cm and 30-60cm referred to as top and sub soil respectively. Sampling from predetermined depth was to ensure comparability between samples collected from different sampling quadrants. The collected soil samples were then subsequently analyzed at the soil laboratory of the Agronomy department, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria. In all thirty (30) samples was taken from the three communities and then coagulated into six (6) samples by taking means of the 10 samples per location. The six samples were them plotted and interpolated using inverse distance weighted interpolation techniques in ArcGIS to show the spatial distribution of the samples across the study area. The analytical procedures adopted in carrying out the tests are as presented on Table 1.

A focus Group Discussion was conducted among selected farmers of where the soil samples was drawn to ascertain the past and present management practice that has been used on the soil and establishing the most adequate practices for them. The focus group discussion was also used to obtained information on the factors responsible for soil degradation in the study area.




Source: Author's Design, 2016.

***Figure 2.*** *Locations of Sampling Points on Quadrant.*

***Table 1.*** *Analytical Procedures Adopted in Investigation.*

*Physical Properties*

| Test | Method and Procedure | Other users |
|---|---|---|
| Particle size distribution (sand, silt and clay) | The Hydrometer method.<br>This method is popular among geographers geologist and engineers (Areola and Farina 1978). The method is fast and can accommodate many samples. This method is based on the change of density of a soil and water suspension upon the settling of the soil particles. Stokes' law will be used to predict the settling times for various sized particles. Stokes' law states that the rate of which particles fall in a viscous medium (water) is governed by the radius of the particles and the force due to gravity. A special hydrometer, calibrated in terms of the grams of soil suspended, will then be used to measure density. The hydrometer will be gently placed on the cylinder containing the suspension after predetermined periods of time and a reading taken by determining where the meniscus of the suspension strikes the hydrometer. [2] | Van Reeuwijk, (1992) |
| Bulk density | Core methods of Black.<br>This William be determined by the undisturbed core sampling method after drying the soil samples in an oven at 105°C to constant weights, while particle density was measured by the pycnometer method (Black, 1965). Percentage pore space was computed from the values of bulk density (BD) and particle density (PD) (Brady and Weil, 2002) as:<br>Total pore space (%) = (1-BD/PD) x 100 | Black 1965 |
| Water holding capacity | This will be determined by first saturating the soil samples with water and later subjected to gravitational draining for 24 hours. To prevent moisture loss, the samples will be covered with polythene. The sample will later be weigh and oven-dry for 24 hours at 105°C of temperature. The loss in weigh will be expressed as percentage of the oven-dry soil. | Klute (1965) |

*Chemical Properties*

| Test | Method and Procedure | Other users |
|---|---|---|
| Phosphorus | Bray No 1 method.<br>To obtain phosphorus, Extracts from soil samples will be leached with Bray P-1 extracting solution (0.025N HCL+0.03N $NH_4F$). The concentration of phosphorus will be expressed in parts per million (ppm). | Olsen and Dean (1965) |
| Nitrogen | Kjeldahl digestion.<br>This involves the digestion of soil samples with concentrated sulphuric acid and auto analysis of the digest to determine the Nitrogen concentration in the soil samples. [3] | Black (1965), Bremner and Mulvaney, (1982) |
| Exchangeable cations | Ammonium acetate method<br>This will be used to determine the calcium and magnesium in the soil samples by atomic absorption spectrophotometer while potassium and sodium will be determined by flame photometry. This involves leaching. [4, 8] | Rowell (1994) |

Sources: Authors Compilation (2016)

## 4. Result and Discussion

Physicochemical laboratory results on waterholding capacity, bulk density and particles size distribution of the samples taken were presented in Table 2 while that of the Available Pottasium, Phosphorus, Calcium, Magnesium, Nitrogen and other micro nutrients were presented in Table 3.

Table 4 and 5 shows the t-test results of the physical and chemical characteristics of soil samples. The P-value result of t test of physical characteristics of the soil samples at 0-30cm was (0.372) and 30-60cm (0.392) is greater than 0.005, that is P>0.005 which means it is not statistically significant. According to Table 4 the results shows that they are not different from another despite the difference in depth

***Table 2.*** *Physical Characteristics of Soil Samples.*

| S/N | Location | Water holding capacity | Bulk density | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|
| 1 | Agbamu 0-30cm | 0.89 | 2.26 | 76.24 | 2.88 | 20.88 |
| 2 | Agbamu 30-60cm | 0.90 | 2.25 | 78.40 | 0.80 | 20.80 |
| 3 | Okeya 0-30cm | 0.68 | 2.09 | 76.96 | 1.44 | 21.60 |
| 4 | Okeya 30-60cm | 1.21 | 2.89 | 78.40 | 2.16 | 19.44 |
| 5 | Rore 0-30cm | 0.88 | 2.10 | 73.36 | 3.60 | 23.04 |
| 6 | Rore 30-60cm | 0.94 | 2.06 | 78.40 | 0.00 | 21.60 |

Source: Author's Fieldwork (2016)

***Table 3.*** *Chemical Characteristics of Soil Samples.*

| S/N | Location | pH | AP | Ca | Mg | Na | K | EA | CEC | %N |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Agbamu 0-30cm | 7.8 | 1.548 | 0.0004 | 0.0008 | 0.0045 | 0.0666 | 0.23 | 0.302 | 0.112 |
| 2 | Agbamu 30-60cm | 7.6 | 1.500 | 0.0003 | 0.0007 | 0.008 | 0.0615 | 0.42 | 0.491 | 0.084 |
| 3 | Okeya 0-30cm | 7.4 | 1.244 | 0.0012 | 0.0009 | 0.0081 | 0.1180 | 0.31 | 0.499 | 0.394 |
| 4 | Okeya 30-60cm | 7.7 | 1.580 | 0.0010 | 0.0008 | 0.0044 | 0.0974 | 0.43 | 0.534 | 0.168 |
| 5 | Rore 0-30cm | 7.6 | 2.314 | 0.0005 | 0.0010 | 0.0087 | 0.0872 | 0.32 | 0.417 | 0.140 |
| 6 | Rore 30-60cm | 7.4 | 1.356 | 0.0003 | 0.0013 | 0.0071 | 0.0564 | 0.25 | 0.315 | 0.280 |

Source: Author's Fieldwork (2016).

***Table 4.*** *Independent Samples T-test on physical characteristics of soil samples.*

| Variables | | Paired Differences | | | | | T | Df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | 0-30 | 20.4700 | 32.0031 | 14.3122 | 20.1159 | 48.0879 | 0.946 | 8.00 | 0.372 |
| Pair 1 | 30-60 | 6.4840 | 8.3232 | 3.7222 | 25.2208 | 53.1928 | 0.946 | 4.539 | 0.392 |

Source: Author's Data Analysis, (2016).

***Table 5.*** *Independent Samples T-Test on chemical characteristics of soil samples.*

| Variables | | Paired Differences | | | | | T | Df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | 0-30 | 1.1526 | 2.4751 | 0.8250 | -2.4480 | 2.4951 | 0.020 | 16.0 | 0.984 |
| Pair 1 | 30-60 | 1.1290 | 2.4713 | 0.8237 | -2.4480 | 2.4951 | 0.020 | 16.0 | 0.984 |

Source: Author's Data Analysis, (2016).

The P value of the t test result for chemical properties revealed that is not statistically significant because the P value is >0.005 the depth 0-30cm and 30-60cm value was 0.984 for both the top soil and sub soil. Based on this result it shows that the agricultural landuse practice in the study area has not really affected both physical and chemical composition of the soil. The major reason is that the soil in the study area is endowed with soil organic matter and this plays a significant role in boosting soil fertility and helps to control microbial activity which serves as a source of carbon and nitrogen. [10]

The focus group discussion conducted identifies the management practices that the farmers has been using to manage their soil from been degraded. However, one of the methods identified was Crop Rotation. The farmers employed Crop Rotation method to manage their soil because its helps maximize crop yield potential because there are often yield bump for crops grown in rotation. It is an important strategy in managing insects, diseases and weeds. Over time, crop rotations can help increase soil organic matter, reduces soil erosion and runoff, and improve soil physical properties. Crop rotation helps spread the workload during the growing season and mitigate risk from weather events when a variety of crops are planted across the entire farming operation. Rotating different types of soil allows the grower to diversify their herbicide program and select chemistries with different modes of action. Crop rotation can balance the production of crop residues when crops that produce durable residue such as corn are rotated with crops that produce more fragile residue like soybeans (Al-Kaisi *et al.,* 2003). Crop rotation, especially combined with conservation tillage, will lead to higher soil-carbon content and so contribute to combating climate [9]. Another method used by the farmers in the study area is Mulching. Mulching is used to control erosion in the farmland. Mulching is done by putting dead leaves and shredded wood on the soil. Mulching acts as a protective covering for the tree and plants against extreme weathers. Mulching allows water to reach the soil slowly, and thus reduce the impact of rainfall or heavy watering. Mulches help to prevent the soil from turning acidic and suppress weeds from growing. Over time, mulches made from organic materials break down and increase soil's structure and fertility. Contour farming and terracing is also been used by farmer to control erosion. The practice of tilling sloped land along lines of consistent elevation in order to conserve rainwater and to reduce soil losses from surface erosion. Contour farming act as reservoirs to catch and retain rainwater, thus permitting increased infiltration and more uniform distribution of the water.

## 5. Conclusion and Recommendations

These variations of soil physic-chemical properties between land use types indicate the risk to the sustainable crop production in the area. The top soils have more mineral elements to aid the growth of plants than the sub soil and depth does not impede the movement of minerals within the soil. Therefore, strategies to feed the expanding population in the study areas will have to seek a sustainable solution that better addresses integrated soil management. Based on the findings of the study, the following recommendations were made:

i. To avoid soil degradation and complete crop failure, farmers should be enlightened on soil management as well as the application of appropriate and adequate amount of fertilizer. This will help the soil regain its nutrients taken up by plants and ensure continuity for cultivation.

ii. The information gap between the research institution and the practicing farmers should be filled up. Research findings result should be related back to the farmers and information on how to use their soil sustainably should be dispatched to farmers.

iii. Accessibility to environmental information by the farmers that will enable them to be fully aware of the implications of their activities on the environment and to participate more effectively in decision making process on how to solve their environmental challenges.

iv. Adequate attention should be given to community needs and diverse knowledge system which incorporates indigenous knowledge of erosion control, farming methods and social sensitivities of the locals..

v. Erosion being a natural process, however human anthropogenic activities have provoked it's incidence at an alarming rate but if enough awareness is made available with respect to sustainability of the physical resources, then man could have probably found a lasting panacea to the accompanied threat.

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